Comparative (Dis?)Advantage in Russian Agriculture

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The economic reform that began in Russia in the early 1990s has spurred major changes in the structure and volume of the country's agricultural production and trade. This paper examines whether Russia has a comparative advantage in agricultural outputs compared to agricultural inputs, and whether it has a comparative advantage in bulk crops versus meat. The paper also investigates whether the changes in Russia's agricultural production and trade during transition have been consistent with the country's agricultural comparative advantage, as indicated by the empirical results.

Method of Calculation

The two measures most commonly used to assess a country's comparative advantage (CA) *vis-à-vis* the world market are the domestic resource cost (DRC) and social cost-benefit ratio (SCB). The DRC is the older measure, used in many studies that examine CA in developing and, more recently, transition economies (Alpine and Pickett; Appleyard; Gorton, Davidova, and Ratinger). The DRC of good i is calculated as

$$\text{(1)} \qquad \text{DRC}_i = \frac{P_i^d + (s_i - t_i) - \sum_j a_{ij} P_j^d}{P_i^b - \sum_j a_{ij} P_j^b}$$

where

P_i^d is the domestic producer price of good i;
s_i is the per unit subsidy in the form of government transfer payments to producers of good i;
t_i is per unit explicit taxes imposed on producers of good i;
a_{ij} is the units of tradable input j used to produce one unit of good i;
P_j^d is the domestic producer price of tradable input j;
P_i^b is the border (trade) price of good i, expressed in domestic currency; and
P_j^b is the border (trade) price of tradable input j, expressed in domestic currency.

The DRC gives the value of the *nontradable* domestic resources used to produce one unit of the good, divided by the net foreign exchange, measured in domestic currency, that the good would earn if exported. The DRC approach measures CA based on the assumption that countries move to free trade in all tradable goods, including inputs. This means that the appropriate opportunity cost value of tradable inputs is the trade price. Since the values used for tradable inputs in both the numerator and denominator of the DRC measure would be equal (at the trade price), the convention is to leave values for tradable inputs out of the calculation. This explains why in equation (1) values for these inputs are subtracted out. The denominator thereby gives the foreign exchange earned from exporting the domestic nontradable inputs embodied in the good.

Conceptually, the numerator should measure the opportunity cost of nontradable inputs, given by their marginal cost. The *full producer incentive price* for a good is defined as the domestic market price (P_i^d) plus per unit net subsidies in the form of transfer payments from the government ($s_i - t_i$). Thus, the formula in equation (1) assumes that producers are profit-maximizing and that domestic markets are working sufficiently well such that producer incentive prices adequately measure marginal (opportunity) costs of production.

DRCs can be used to rank a country's tradable goods on a CA spectrum. If the DRC for good A is less (greater) than the DRC for good

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B, the country has a CA (CD—comparative disadvantage) in A relative to B. DRCs can also be used to determine if a country is cost competitive in goods *vis-à-vis* the world market. If the DRC for a good is less than 1, domestic production of the good is economically efficient. The opportunity cost of resources used in production is less than the foreign exchange earned (expressed in domestic currency) if the good were exported. The country would benefit if more of the good were produced for export. If the DRC is greater than one, domestic production of the good is inefficient. The opportunity cost of resources used in production exceeds the foreign exchange cost of importing the good. The country would benefit if imports were substituted for domestic production.

The more recently created SCB measure (Masters and Winter-Nelson, Fang and Beghin) for good i is calculated as

$$(2)\quad \mathrm{SCB}_i = \frac{P_i^d + (s_i - t_i) + \sum_j a_{ij}\left(P_j^b - P_j^d\right)}{P_i^b}$$

where all variables are defined as in equation (1). The SCB gives the value of *all* resources used to produce the good, with tradable inputs valued at trade prices, divided by the total foreign exchange, measured in domestic currency, that the good would earn if exported. Rather than subtracting the value of tradable inputs from both the numerator and denominator, the SCB includes these inputs in both the parts valued at trade prices. In the numerator in equation (2), this involves adding to the good's domestic incentive price the difference between the border and domestic price for each tradable input, times the input's input-output coefficient. In the denominator, the value of tradable inputs is embodied in the good's border price (P_i^b). As with the DRC, a lower (higher) SCB value for good A than for good B means that the country has a CA (CD) in A relative to B. Also, a ratio less (greater) than one means that the country is cost-competitive (uncompetitive) in the good.

Masters and Winter-Nelson argue that the SCB is a superior measure of CA than the DRC. They argue (backed up by proof) that the DRC overstates the relative profitability of producing and trading goods that intensively use tradable inputs in production. We find their argument convincing, and therefore use the SCB as the basis for computing CA measures for Russia.

Context and Data

We calculate SCBs for the meats (beef, pork, and poultry), major bulk crops for Russia (wheat, barley, and sunflowerseed, the main oilseed of the country), fertilizer (nitrogen, phosphate, and potash), and energy (crude oil and natural gas). SCBs are computed for 1996–97. When all measurement difficulties are taken into account, these are the best years during the 1990s to measure Russia's CA.

As mentioned before, the main assumption in our calculations is that domestic markets are operating sufficiently well that producer incentive prices correspond to marginal production costs. In 1996–97, markets for both agricultural outputs and inputs in Russia were still operating imperfectly. For many goods, the law of one price still did not hold throughout the country. The main problem was (and remains) regional segmentation of markets. The main causes are poor physical and market infrastructure and government policies, such as restrictions on agricultural flows (mainly outflows) by regional authorities (Liefert and Swinnen). Yet, within regions, state restrictions on markets are not onerous, such that intra-regional prices correspond fairly well to production costs. This supports our assumption that national average producer prices are an acceptable measure of national opportunity costs. Thus, the producer prices we use to calculate the SCBs are national average prices.

High inflation creates problems in measuring CA, as prices in any year can over- or undershoot real marginal production costs. During each transition year before 1996, inflation in Russia exceeded 100%. When the financial crisis of August 1998 hit, prices jumped again, by about 120% over the next twelve months. In contrast, producer prices in 1996 and 1997 were relatively stable, rising only 25% and 7%.

The high inflation following the financial crisis does not seriously outdate our assessment of Russian CA based on measures in 1996–97. A country's CA depends on its cost structure relative to trade prices. Although a country's nominal prices can change quickly, its underlying cost structure generally cannot. One might argue that the very nature of transition creates the opportunity for a country's cost structure to change rapidly. Yet, this has not been true of Russian agriculture during transition, as the pace of technological change and systemic reform has not been fast

(Organization for Economic Cooperation and Development, Liefert and Swinnen).

Another potential problem concerning the "representative valuation" of domestic output involves crops. Weather is volatile in Russia, such that crop harvests can vary substantially between years. Large fluctuations in output make production costs and prices also change. We therefore want the years for which we compute SCBs to have crop harvests as close to "normal" as possible. The average annual grain production over 1994–99 was 67 million metric tons (mmt). The 1996 and 1997 harvests were 69 and 88 mmt. Thus, 1996 was a good representative year for crop production, while 1997 was a good weather and output year, making it a bad representative year. The data show that the bountiful 1997 harvest reduced domestic producer prices. Thus, the SCB calculations for crops in 1997 somewhat overstate their price competitiveness.

The analysis of a country's CA also requires appropriately representative trade prices. World trade prices for both agricultural goods and energy have not been steady during the last five to six years. Generally speaking, in 1996–97 world prices for agricultural commodities were relatively high, while in the years both before and after this period they were low. For example, U.S. export prices for a ton of wheat in 1994, 1996, and 1999 equaled $4.09, $5.63, and $3.04 per bushel, respectively (Economic Research Service). A quantitative analysis of Russia's CA in 1996 and 1997 would strongly favorably bias the CA of Russian agricultural output.

Thus, in our calculation of SCBs using equation (2), the border price used for all goods (inputs as well as outputs) is the annual average over the period 1994–99. Since the value in the denominator of the SCB is a six-year average, it would be inconsistent to make separate calculations of the domestic value of goods in 1996 and 1997 to use in the SCB numerators. Therefore, single SCB calculations are made for the period 1996–97. The numerator for a good equals the average of the producer incentive price for 1996 and 1997, and the denominator equals the average of the border price over 1994–99.

The last major variable to be considered in the calculations is the exchange rate. Since official Russian foreign trade data are given in U.S. dollars, an exchange rate is needed in equation (2) to convert border prices from dollar to rouble values. (The values in the official data are not initially priced in roubles and then converted to dollars via the exchange rate. Rather, the vast bulk of Russia's foreign trade, including with other countries of the former USSR, is originally valued in U.S. dollars or other Western currencies.) During the 1990s, however, the Russian exchange rate (both nominal and real) was highly unstable. The rouble plunged in value *vis-à-vis* hard currencies in 1992, then began a major appreciation in real terms. It then depreciated substantially in both nominal and real terms when the financial crisis of August 1998 hit. Thus, even use of the "average" exchange rate over 1994–99 would be highly problematic in terms of interpretation. To avoid using the Russian exchange rate, we modify the SCB calculations such that the border price in the denominator is expressed in U.S. dollars, not Russian roubles.

With this formulation of the SCB, we cannot test whether Russia is cost-competitive in goods *vis-à-vis* the world market (if the DRC for a good is less (greater) than 1, it should export (import) the product). However, we can still rank goods according to CA. Determining whether goods have a CA *vis-à-vis* each other can be as informative as determining whether goods are competitive (at existing exchange rates) *vis-à-vis* the world market.

The producer prices, border prices, and subsidy data for Russian agricultural goods were obtained directly from the Organization for Economic Cooperation and Development. The source for producer prices for fertilizer and energy is *Tseni* v *Rossii* (Russian Federation State Committee for Statistics). The border prices for fertilizer and energy used in the calculations are unit values, computed from the trade volume and value data in *Tamozhennaia Statistika* (Russian Federation State Customs Committee).

Calculation of SCBs in equation (2) requires input/output coefficients for those tradable inputs whose domestic price deviates from the border price. We make this price adjustment for the following output-input combinations:

beef, pork, and poultry: animal feed and energy
wheat, barley, and sunflowerseed: fertilizer and energy
nitrogen, phosphate, and potash fertilizer: energy
crude oil and natural gas: energy

The sources used to compute the input/output coefficients are varied. Russian feed requirements by animal type are from the

Economic Research Service, U.S. Department of Agriculture forecasting model for Russian agriculture. For energy used as inputs, the main source is the *Russian Statistical Yearbook* (Russian Federation State Committee for Statistics, annual). Concerning fertilizer use, the *Statistical Yearbook* gives the total amount of fertilizer used to produce various agricultural products, but not the specific quantity of the three main types of fertilizer used (nitrogen, phosphate, and potash). The technical nature of fertilizer use is such that fairly fixed proportions have to be employed for each specific crop. The shares of the various types of fertilizer employed in crop production in the United States (Ali and Brooks; Ali, Brooks, and McElroy) is used to determine fertilizer shares by crop in Russia.

Results

The calculations in table 1 indicate that Russia has a comparative disadvantage (CD) in agricultural outputs *vis-à-vis* agricultural inputs. The country also appears to have a CD in meat relative to bulk crops. The CD in poultry seems particularly pronounced. Since bulk crops provide livestock production with the input of animal feed, meat's CD *vis-à-vis* crops reinforces the overall finding thatRussia has a CD in agricultural outputs *vis-à-vis* inputs. The results indicate a strong CA in energy, especially natural gas.

The pattern of Russia's CA in agricultural outputs and inputs as indicated by the calculations is consistent with the country's trade during the second half of the 1990s. This suggests that Russia's agricultural trade in general is economically rational. Table 1 shows that in 1996–97 Russia was a major importer of meat, with imports in the two years accounting for about 30% of total meat consumption. The country was also a major exporter of energy products, which made up almost half of its exports in value terms. The country was a small net exporter of wheat and grain in total. This is generally consistent with the SCB calculations, which for grain show values close to the average for all the products, as well as values not too far from those for fertilizer, a major input for crops. However, Russia was a major exporter of sunflowerseed, with exports in 1996–97 constituting about half of the output. This is consistent with the CA ranking of sunflowerseed *vis-à-vis* the grains and fertilizer.

Russia is also a major exporter of fertilizer. In fact, in 1996 and 1997 Russia exported over 80% of its total fertilizer output, mostly to EU countries. Yet the SCB calculations do not appear to show a strong CA for fertilizer *vis-à-vis* crops. Nevertheless, the SCB calculations are

Table 1. Russian Social Cost-Benefit Ratios and Trade Balances

Product	SCB Ratios (1996–97)	Trade Balances[a] 1996	1997
		Million tons	
Meats			
Poultry	13.45	−0.74	−1.14
Pork	8.21	−0.30	−0.30
Beef	6.61	−0.45	−0.61
Crops			
Wheat	7.06	−1.70	−1.60
Barley	6.94	−0.46	−0.76
Sunflowerseed	4.37	1.77	1.04
Fertilizer			
Nitrogen	7.25	8.31	6.13
Phosphate	6.53	1.22	1.31
Potash	4.69	3.61	4.93
Energy			
Crude oil	3.30	107.01	108.94
Natural gas	0.59	180.14[b]	180.65[b]

Source: Own calculations for SCB ratios, and Russian Customs Committee for trade balances.
[a]Negative value means net imports.
[b]Billions of cubic meters.

consistent with the country's fertilizer trade. A key feature of the SCB calculations is that they measure CA/CD *at the margin*. Assume that in 1996 Russia did not export any fertilizer, and that the calculated SCB value for nitrogen fertilizer was three. Russia then starts producing nitrogen fertilizer for export. Rising output would raise the marginal cost of production, and thereby the domestic producer price as well. Also, Russia clearly has market power in the world market for fertilizer. As it exports more nitrogen fertilizer, it would drive the trade price down, thereby reducing the price it receives for its exports. The effect of a rising domestic price for nitrogen fertilizer and falling export price would be to increase the calculated SCB.

That the SCB calculations for fertilizer are close to those for grain suggests that, in terms of the tradeoff between producing more fertilizer for export or producing more for domestic crops, further growth in fertilizer exports would appear not to be rational. However, the large volume of existing fertilizer exports is economically rational, as it has driven the calculated SCB values close to those for grain. Without the big exports, the fertilizer SCBs would probably be well below those for grain.

The point that the SCB calculations measure CA *at the margin* also supports the conclusion that Russia has a CD in meat relative to crops, and that large meat imports are consistent with the SCB calculations. The SCB for pork is not much above those for wheat and barley, while the calculation for beef is below those for the two grains. Only the calculation for poultry is much higher than that for grain. However, in 1996–97, net imports of beef, pork, and poultry equaled 26%, 24%, and 180%, respectively, of domestic production of these meats. What would the SCBs for meat in these years look like in the absence of trade—that is, how would the SCBs change if Russia, instead of importing meat, had produced more meat exactly equal to the volume of net imports, such that total consumption of the three types of meat were unchanged? Higher meat production would raise marginal costs and domestic prices, thereby increasing the SCBs. Such nontrade SCBs would show a greater CD in meat *vis-à-vis* crops *at the margin*. To import meat (especially poultry) would look even more economically rational.[1]

The SCB calculations can also be used to assess the economic rationality of the major changes in Russian agricultural production and trade that have occurred during transition. The well-documented changes (see Organization for Economic Cooperation and Development) have been a halving of livestock production and inventories, large rise in meat imports, elimination of the large imports of grain and oilseeds used during the Soviet period for animal feed, and exportation of most fertilizer output as production of grain and other crops dropped. These changes are all consistent with a general CD in livestock products *vis-à-vis* crops, and a CD in agricultural outputs *vis-à-vis* agricultural inputs. The results support the general conclusion that the livestock sector expanded during the Soviet period to an economically unprofitable level.

The assessment of Russian agricultural CA based on the SCB calculations is consistent with Liefert's (1990, 1994) assessment of agricultural CA in the USSR. He finds that in the 1980s, the USSR had a CD in both meat and grain *vis-à-vis* natural gas and crude oil, and a CD in meat *vis-à-vis* grain.

Why during transition has Russia not been at its optimal level of agricultural trade—that is, why have (relative) producer incentive prices differed from (relative) trade prices? The two main reasons are those identified earlier when the issue of domestic market segmentation was addressed: government policies (mainly at the regional rather than national level) and poor physical and market infrastructure.

Conclusion

The results indicate that Russia has a *disadvantage* in agricultural outputs compared with its agricultural inputs. The country also has a disadvantage in meat compared with its bulk crops (grain and sunflowerseed, the country's main oilseed), which provide animal feed. A comparative advantage in energy is indicated, as well as an advantage in fertilizer compared to crops. The results are consistent with and help explain the major changes in Russian agricultural production and trade during

[1] The optimal volumes of trade will be achieved when the SCB measures are equal for all tradable goods, this convergent value being equal to the (at least trade-based) "equilibrium" exchange rate. For comparison, in 1996 and 1997 the (average monthly) rouble/dollar exchange rate was 5.12 and 5.78 roubles to the dollar. (Actually, the exchange rate in the two years was about 5,125–5,785 roubles to the dollar. In January 1998, a currency reform re-based the entire monetary, price, and exchange rate system by dividing all rouble values by 1,000.)

transition. These include the severe contraction of the livestock sector, large rise in meat imports, termination of the substantial Soviet-era imports of grain and oilseeds used as animal feed, and exportation of the bulk of the country's fertilizer.

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